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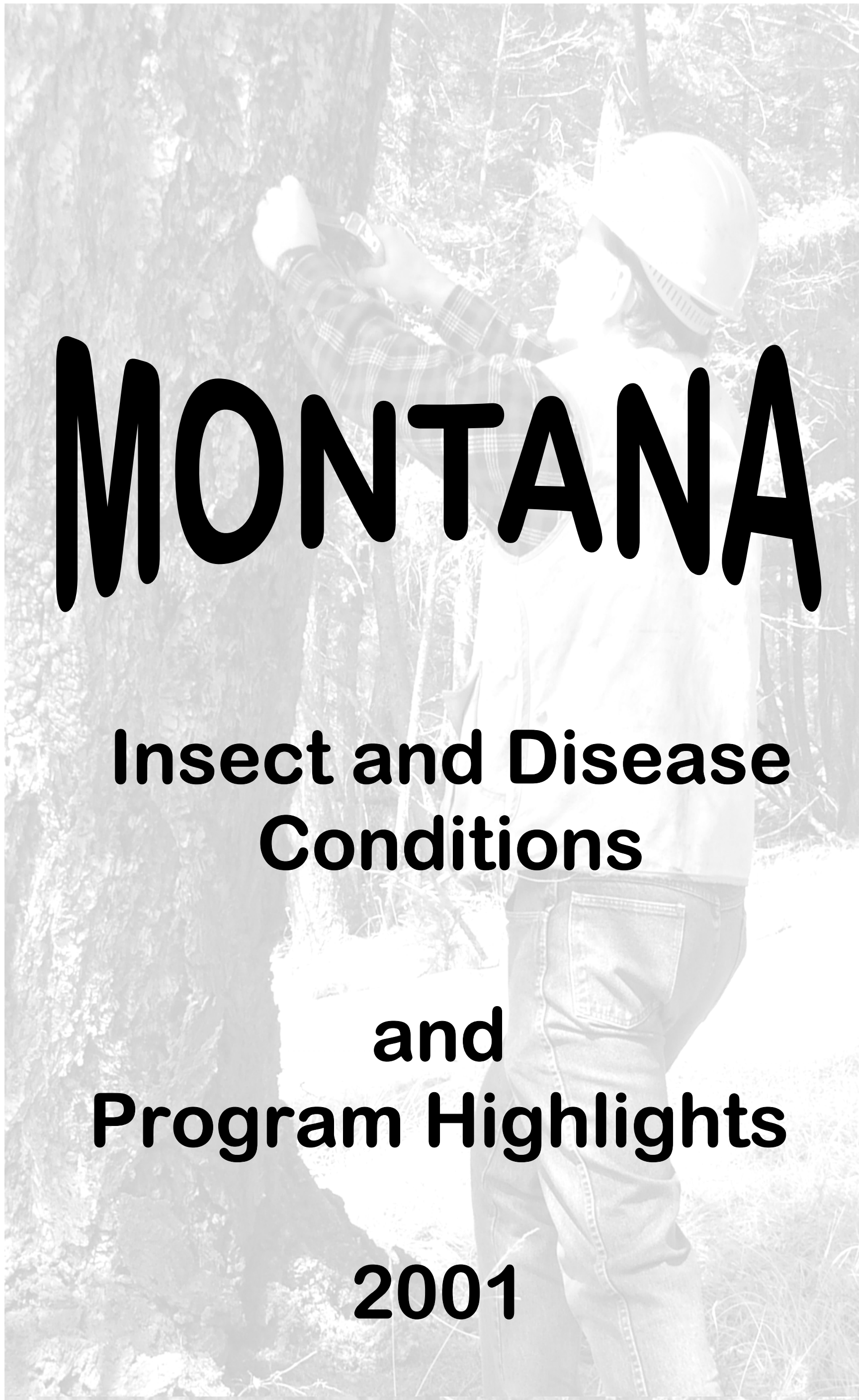

MONTANA

Insect and Disease Conditions

and Program Highlights

2001

Report 02-1

Montana Department of Natural Resources and Conservation

Forestry Division

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Forest Insect and Disease Conditions and Program Highlights - 2001

Report 02-1

2002

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Application of MCH bubble capsule to Douglas-fir, courtesy of Ken Gibson, USDA Forest Service, Northern Region, State and Private Forestry, Forest Health Protection

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INTRODUCTION

This report summarizes the major forest insect and disease conditions in Montana during 2001 and was jointly prepared by the Montana Department of Natural Resources and Conservation, Forestry Division and USDA Forest Service, Forest Health Protection (FHP), State and Private Forestry, Northern Region. Information for the report was derived from ground and aerial surveys across parts of Montana.

SUMMARY OF CONDITIONS

Fire and Bark Beetles

Following the worst fire season in the Region in more than 80 years, and in response to continuing warmer- and drier-than-normal weather, bark beetle populations continued nearly unabated in 2001 (Table 2). Though fire incidence in 2001 was reduced compared to 2000, a few large fires—especially Moose on the Flathead NF and Fridley on the Gallatin NF—will likely provide additional brood sites for bark beetles. In many areas, and those in particular, we may anticipate building Douglas-fir beetle and perhaps Engelmann spruce beetle populations in 2002. In other parts of the state, mountain pine beetle populations significantly continued to increase in overmature lodgepole pine stands—specifically the western part of the Lolo NF, the Deerlodge portion of the Beaverhead-Deerlodge NF, and the southeast part of the Flathead. Continued favorable environmental conditions throughout the state have resulted in epidemic populations of several bark beetle species.

Defoliators

Only one gypsy moth was caught in the state of Montana in 2001. The moth was caught at the Swiftcurrent campground in Glacier National Park. A delimitation survey is planned near the positive catch in 2002. Aerial surveyors mapped 1,300 acres of defoliation by western spruce budworm east of the Continental Divide on the Helena National Forest. There was a significant increase in number of moths caught at several trapping sites, while number of moths caught at other sites decreased slightly or remained relatively unchanged. We expect to see increases in budworm populations in 2002 on the Helena and Beaverhead-Deerlodge National Forests. Defoliation by both western hemlock looper and false hemlock looper were observed. The false hemlock looper defoliated Douglas-fir on the northwest side of Flathead Lake. The hemlock looper defoliated Douglas-fir east of Missoula near Holloman Saddle and northwest of Lincoln near Black Mountain in Lewis and Clark County. The Douglas-fir tussock moth defoliation that occurred on the Flathead Indian Reservation, just south of Saint Ignatius, in 2000, was monitored in 2001. Many of the trees that were heavily defoliated in 2000 had put on a new flush of needles, though many were dead. Some visible defoliation in 2001 was detected in the same area, but was caused by a population of western false hemlock loopers. Scattered tent caterpillar damage was again seen in western Montana. A significant area of tent caterpillar defoliation was observed in cottonwood between Lindbergh and Holland Lakes south of Swan Lake.

Root Diseases

Mortality and growth losses from root disease continue to be high throughout the state. Root disease-caused mortality is more common west of the Continental Divide, although large patches can be found east of the Divide. The effect of the fires of 2000 on root diseases is one of opportunity. The tree species that are best adapted to low intensity, high frequency fires, are those species that are also root disease-tolerant, such as western larch and ponderosa pine. In the root diseased areas that burned, there is the opportunity to reduce the effects from root disease by planting these species or encouraging the natural regeneration of these species.

Dwarf Mistletoes

Dwarf mistletoe continues to cause losses of approximately 33 million cubic feet annually. Douglas-fir, western larch and lodgepole pine are the tree species most severely affected. Fire greatly influences the distribution of dwarf mistletoes across the landscape. In general, any fire event that kills infected trees will reduce the population of dwarf mistletoe, at least in the short term. Large, complete burns will greatly reduce dwarf mistletoe populations across the landscape and may even eliminate small, localized populations. Small, patchy burns will temporarily reduce the amount of mistletoe, but infected residuals provide a ready source of dwarf mistletoe seeds for the infection of the new regeneration.

White Pine Blister Rust

White pine blister rust continues to be present throughout the range of five-needle pines in the state. Rust severity is highest in the northwestern part of the state where the disease continues to cause extensive mortality in western white pine.

Limber Pine Decline

Limber pine decline and mortality appear to be continuing across scattered locations in central and eastern Montana. Permanent plots to monitor the decline were established in 1996 at various locations near Stanford, Monarch, Clyde Park, and Dewey. Data were not collected from these plots in 2001, but are scheduled for remeasurement in 2002.

Abiotic Damage

Chloride Damage

We received requests for assistance from several locations to evaluate damage to roadside trees potentially due to the use of magnesium chloride as dust abatement. The areas in question were private land in the Seeley/Swan area (Montana DNRC Trip Report); Basin Creek Road on the Butte RD, Deerlodge NF (TR 01-13); and the East Boulder River Road on the Big Timber RD, Gallatin NF (TR 01-14). All three areas had various treatments of magnesium chloride as dust abatement. The trees along the roads had foliage with tip burning, completely red foliage, and branch dieback. These symptoms were concentrated within 20 to 30 feet from the road edges, in all size classes of trees. Symptoms were sometimes more noticeable on the sides of trees facing the roads, but were also commonly found in a spiral pattern within affected trees. The tree species most affected in Montana was Douglas-fir.

Foliage was collected from symptomatic trees along the Basin Creek Road and East Boulder River Road and analyzed for chloride levels. Preliminary analyses indicate the chloride content of the symptomatic trees is much greater than in the non-symptomatic trees. Drought is thought to be a contributing factor in the symptoms observed. A more thorough report is forthcoming which will detail the findings and potential implications.

ANNUAL AERIAL SURVEY

The annual aerial detection survey in Montana was conducted from July 2 until September 20, 2001. The survey covered approximately 20.9 million acres of mixed ownership forestlands, excluding most wilderness areas (Figure 1). Four FHP sketch mappers, using three different airplanes, conducted the 2001 aerial survey.

Much of the data summarized in this report is a product of the aerial survey, as well as ground surveys and biological evaluations. Along with the data summaries, aerial survey maps are available from the Missoula FHP Field Office, in both paper and digitized GIS format.

The annual aerial detection survey is an overview survey designed to cover large areas in relatively short periods. Aerially detected signatures include tree mortality, defoliation and windthrow. If forest disturbance activities are low, secondary disturbances such as diseases, needle casts, high-water damage and previous fire

damage are sketch mapped. The intent of the survey is to cover each area once a year during which time the observer sketch maps as many disturbances and damage as possible. The survey is conducted using single-engine, high-wing airplanes, flying at speeds of approximately 90 to 130 M.P.H., at an average altitude of approximately 1,000 to 2,000 feet above ground level.

The aerial survey data are estimates made from airplanes and though not as many areas were ground checked as we would like, enough were checked to lend confidence to the areas for which we only have aerial survey data. Together, aerial and ground surveys provide information relative to bark-beetle-caused mortality, as well as other damage agents, pertinent to land managers charged with the responsibility of maintaining forest health.

INSECTS

Abbreviations

The following abbreviations are used for beetles and their hosts throughout the bark beetle section:

Beetles	DFB	=	Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins
	ESB	=	Spruce beetle, D. *rufipennis* (Kirby)
	IPS	=	Pine engraver, *Ips pini* (Say)
	MPB	=	Mountain pine beetle, *D. ponderosae* Hopkins
	WPB	=	Western pine beetle, *D. brevicomis* LeConte
	FE	=	Fir engraver, *Scolytus ventralis* LeConte
	WBBB	=	Western balsam bark beetle, *Dryocoetes confuses* Swaine
	RTB	=	Red turpentine beetle, *D. valens* LeConte

Hosts	LPP	=	Lodgepole pine
	PP	=	Ponderosa pine
	WWP	=	Western white pine
	WBP	=	Whitebark pine
	DF	=	Douglas-fir
	GF	=	Grand fir
	SAF	=	Subalpine fir
	ES	=	Engelmann spruce

Other	NF	=	National Forest
	RD	=	Ranger District
	IR	=	Indian Reservation
	BLM	=	Bureau of Land Management

BARK BEETLE CONDITIONS IN BRIEF

Mountain Pine Beetle (MPB). For the first time in nearly 10 years, when almost 80,000 acres were infested in 1992, MPB has once again become the most frequently encountered and damaging bark beetle in the state (Tables 4 and 5, and Figure 2). Populations continued to expand in LPP stands on the Lolo, Flathead, and Beaverhead-Deerlodge NFs in western Montana. Hundreds of thousands of acres of LPP are becoming increasingly susceptible, and weather conditions are proving to be increasingly conducive to beetle survival. Both phenomena have enabled beetle populations to increase significantly in the last few years. While MPB populations affecting other host species were significant in some areas, notably PP in eastern Montana, more than 95 percent of the MPB-infested areas were in aging LPP stands. In total, for all affected hosts, infested area has increased from the slightly more than 40,000 acres recorded in 2000, to over 111,000 acres in 2001. Over 1 million host trees were killed in 2000—recorded as “faders” in 2001.

Douglas-fir Beetle (DFB). Douglas-fir beetle populations continued to increase in many parts of western Montana (Table 3, Figure 3). That was particularly true on Forests that had significant acreages affected by fire in 2000. Fire-affected Douglas-fir stands on the Bitterroot and Helena NFs were especially heavily infested by DFB. In other areas, beetle populations remained high simply because environmental conditions were so favorable and ample hosts were available. In total more than 82,000 acres remained infested by DFB to some extent. That is up considerably from the 34,400 acres reported in 2000.

Western Balsam Bark Beetle (WBBB). WBBB populations remained relatively stable in 2001 (Table 6). Last year, just over 28,000 acres were reported infested to some extent. In 2001, that infested area was just slightly less than 28,000 acres. Because not all reporting areas were flown in 2000, infested-acre figures reported for several bark beetle species indicated populations had declined in 2000. We were fairly confident that was not the case. More complete coverage and estimates of mortality have shown that most bark beetle species have remained high, and many have increased in the last year or two. WBBB populations are among those remaining atypically high.

Others. Other bark beetle species—spruce beetle (ESB), fir engraver (FE), western pine beetle (WPB), and pine engraver (IPS)—for the most part were recorded at endemic or sub-outbreak levels (Table 6). There are some areas where ESB, WPB, and IPS populations are increasing because of conditions created by fire, weather, management activities, or a combination of one or more of those factors. Generally, however, populations of these latter four beetle species are not causing management concerns to the extent of the former three.

The following table, and area summaries included throughout this report, show estimates of infested areas and amounts of associated mortality; as gathered through annual aerial detection surveys. Some have been augmented by ground surveys; but time, access, and available personnel limit those. These combined survey methods, then, provide information on extent and intensity of bark beetle infestations.

BARK BEETLE CONDITIONS BY REPORTING AREA

Beaverhead Reporting Area

The Beaverhead Reporting Area was not flown in 2001. The following is a summary from the 2000 report: Conditions on the Forest have not changed significantly except for the potential for bark beetle population buildups in stands affected by the Mussigbrod Fire of 2000.

Wisdom RD. Widely scattered, small groups (5-20 trees each) of WBBB-killed SAF were mapped north and west of the Big Hole Valley. Heaviest concentrations were recorded in upper elevations of Beaver Creek in the Anaconda-Pintler Wilderness. Mortality attributed to WBBB was also widely scattered in SAF stands southeast of the Big Hole, in the Beaverhead Mountains. SAF faders were more numerous and more widely found east of Big Hole Valley in the Pioneer Mountains.

Wise River RD. Occasional, widely scattered small groups of ESB-killed ES, DFB-killed DF and MPB-infested LPP were noted throughout the Pioneer Mountains on the District. Several small groups of DFB-caused mortality were found concentrated east of Grasshopper Creek drainage in Lake Creek and White Creek watersheds.

Dillon RD. Several small groups of SAF, killed by WBBB, were observed southwest of Clark Canyon Reservoir, near Maiden Peak, and along the Continental Divide, southwest of Monida Pass.

Madison RD. From Red Rock Lakes, throughout the Gravelly and Snowcrest Mountain Ranges north nearly to Virginia City, many large groups of WBBB-killed SAF, ranging in size from 5-tree groups to ones of more than 1,500 trees each, were observed. Though infested groups were extensive, they averaged only about 1-2 dead trees per acre.

Bitterroot Reporting Area

Stevensville/Darby RDs. Widely scattered small groups of trees killed by DFB, WBBB, FE and MPB (PP) were noted on the west side of Bitterroot Valley from about the northern Forest boundary, south to Rock Creek. In Rock Creek drainage, west of Lake Como, several small groups of DFB- and FE-killed trees were mapped.

On the east side of the valley, in the Sapphire Mountains, several small, scattered groups of PP have been killed by MPB. Many groups of DFB-infested DF were observed from just south of Squaw Peak to Skalkaho Creek drainage. In that same general area, observers mapped numerous small groups of SAF killed by WBBB at higher elevations. A few groups of LPP faders, killed by MPB in 2000, were seen just north of Owen Point.

In total, on the two Districts, more than 1,400 DF were killed in 2000 by DFB; MPB killed about 330 PP on almost 200 acres; 200 LPP were killed by MPB on about 150 acres; and 530 SAF were killed by a complex of factors—the most obvious being WBBB—on about 170 acres. Other bark beetle effects were less pronounced.

Sula/West Fork RDs. From Tin Cup Creek south to the confluence of East and West Forks Bitterroot River, numerous occurrences of MPB-killed PP were observed. Additional PP, infested by MPB, were also mapped in much of the PP type in the lower elevation of the West Fork drainage.

Throughout the West Fork drainage, west into Nez Perce Fork and Selway River drainages, many large groups of DFB-killed DF were observed. That outbreak is perhaps the largest ever recorded on the Forest. Some groups covered up to several thousand acres and averaged 2-3 beetle-killed trees per acre. Post-fire ground surveys conducted at 12 sites affected by fires of 2000, in the southern Bitterroot Valley, showed an average 23 new DFB attacks per acre, compared to 4 attacks per acre in 2000 (pre-fire).

At higher elevations on the West Fork RD, WBBB-killed SAF is common. In the East Fork drainage, many scattered groups of DFB-killed DF and PP, which had been killed by MPB, were mapped. In the French Basin area, on lands administered by both the State of Montana and Forest Service, significant groups of PP killed by MPB—a few numbering several hundred trees each—were observed.

Total beetle-caused mortality on the two districts was estimated at more than 53.000 DF on just over 35.000 acres; about 1,700 PP killed by MPB on almost 1,150 acres; and 340 SAF infested by WBBB on 172 acres. Other bark beetle-related tree death was negligible.

Custer Reporting Area

Beartooth RD. Several groups of MPB-killed PP, some numbering to 200 trees, were recorded in the Pryor Mountains. Most were noted near Lost Water Creek and Big Coulee in the east and near Black Canyon and Castle Rock in the west. Elsewhere, widely scattered groups of WBBB-affected SAF, from 10 to 250 trees each, were noted. Many of those were in the East Pryor Mountains, and near Teeples Spring. Others were concentrated in the Big Pryor Mountains south of Sage Creek. Also observed were small groups of widely scattered DFB-caused mortality—most of which was in the eastern portion of the reporting district. In total, MPB killed almost 400 PP on 150 acres; and nearly 1,350 SAF were killed by WBBB on 600 acres. DFB affected but 22 trees on 6 acres.
Ashland RD. Small and very widely scattered groups of PP, killed by MPB, were recorded in the southern portion of the reporting area. Drainages most severely affected were Otter Creek and the Tongue River. Much of that damage may be associated with engraver beetles and fire damage from the Stag Fire of 2000. Other widely scattered small groups of MPB-killed PP were mapped northeast of Ashland in the East Fork Otter Creek and its drainages. Total MPB-related PP mortality on the District was estimated at about 565 trees on 450 acres.

Sioux RD. Many small and scattered groups of MPB-killed PP were observed throughout much of the PP type in Chalk Buttes, Ekalaka Hills and the Long Pines. Most recorded groups were small—generally less than 10 trees each—but beetle populations appeared to be building. Similar conditions—small scattered groups of PP, killed by MPB--were noted in the eastern portion of the District, especially in East and West Short Pine Hills, North and South Cave Hills, and Slim Buttes. Estimated MPB-caused mortality on the District totaled about 560 trees on almost 870 acres.

Deerlodge Reporting Area

Butte/Jefferson RDs. Small and widely scattered groups of DFB-killed trees were occasionally mapped on each District. The most notable DFB-caused mortality was observed in tributaries of Boulder and South Boulder Creek drainages. Minor amounts of DF, killed by DFB, were widely scattered throughout dry, DF types. Total DF, killed by DFB, was estimated at about 325 trees on 135 acres.

By far the most significant bark beetle-related condition in that portion of the Forest was the rapidly building MPB outbreak in LPP stands on Butte RD, east and south of Butte. Several large groups of MPB-killed LPP were mapped on East Ridge, just east of Butte; many others were noted in Basin Creek and associated drainages to the east and south. In addition, many large beetle-killed groups of LPP were mapped in the vicinity area of Thompson Park. Several of those groups of "faders" (trees killed in 2000) numbered 200 to 300 trees each.

Ground surveys conducted in November 2001 indicated that groups of faders will be much more numerous and measurably larger in 2002. Surveyed areas varied from LPP stands where the infestation was a couple of years old and faders outnumbered new attacks, to susceptible stands not yet infested. Average numbers of trees killed in the Thompson Park area (data from 3 groups of 10 plots each) were 51 per acre in 2001, compared to 12 per acre killed in 2000. In the Basin Creek area (14 data collection sites of 10 plots each), those averages showed 23 trees killed in 2001, 10 per acre in 2000.

Although data "averages" may not accurately reflect how rapidly that infestation is increasing, in 11 of 17 plot areas, trees attacked in 2001 were significantly higher than those attacked in 2000—the lowest being a ratio of 2:1; the highest being 27:1. Average ratio of increase (2001 attacks: 2000 attacks) for those 11 areas was slightly more than 11:1. Aerial survey estimates for 2001 showed about 4,700 MPB-killed LPP on nearly 1,200 acres. Those figures will be considerably higher in 2002.

Flathead Reporting Area

Spotted Bear RD. Small and somewhat scattered groups of MPB-killed LPP and WWP were noted on both sides of Hungry Horse Reservoir. In addition, widely scattered and small groups of DFB-killed DF were observed throughout DF type on the District. Once again, however, the most significant and damaging bark beetle outbreak on the District (and the Forest) was the still-growing MPB infestation in LPP stands near, and south of, Spotted Bear, in the South Fork Flathead River drainage. Both areas infested and outbreak intensity have increased since 2000. One large group, covering more than 2,500 acres, was estimated to contain three beetle-killed trees per acre. Other groups of more than 1,000 acres each varied from 1-2 trees per acre. Other, smaller groups, of 200-300 trees each were prevalent in the Spotted Bear and South Fork River drainages and their tributaries. Southward, into the Bob Marshall Wilderness, sizeable groups of MPB-killed LPP were noted, especially near Big Salmon Lake. In total, the MPB infestation on the District resulted in an additional 20,200 dead LPP on almost 12,000 acres in 2001. Approximately 24,000 beetle-killed LPP on 4,700 acres had been reported in 2000.

Groups of DF, killed by DFB, some of up to 100 trees each, were mapped in several drainages in the Bob Marshall Wilderness; a notable one was Gordon Creek. Noticeable groups of WBBB-killed SAF were also found at higher elevations—in the Wilderness and other parts of the District, as well. Throughout the District, DFB killed 7,500 DF on 4,700 acres; WBBB killed 500 SAF on 490 acres. In addition to the LPP killed, MPB also killed minor amounts of PP, WBP, and WWP. ESB killed an estimated 70 trees on about 30 acres.

Hungry Horse RD. Many, but mostly small groups of DFB-killed DF, MPB-killed WWP, and WBBB-affected SAF were noted throughout the District—especially on both sides of Hungry Horse Reservoir. LPP, killed by MPB, was common in some drainages in the northeastern part of the District. The most significant groups of WBBB-killed trees were found near Slippery Bill Mountain and at higher elevation sites in Coram Experimental Forest. Others groups were prevalent along Pioneer Ridge. DFB-killed DF were mapped east of Martin City, in the Coram Experimental Forest. That infestation, associated with root disease-affected stands, has existed for several years. Throughout the District, WBBB killed an estimated 1,000 trees on 1,170 acres; 1,100 DF were killed by DFB on 600 acres; and about 770 LPP were killed by MPB on close to 700 acres. Other beetle-caused damage was of less concern.

Glacier View RD. Numerous, but mostly small and widely dispersed groups of DFB-killed DF were noted in many of the tributaries of North Fork Flathead River. Larger groups were noted in Big Creek and Coal Creek drainages, and along the North Fork River drainage near Glacier View Mountain. That area was flown before the Moose Fire began in August. While many stands were severely burned in that fire, and beetle hazard may have been reduced in some; in other stands fire intensity was such that many fire-affected DF are now even more susceptible to DFB than before. We anticipate DFB-caused mortality will increase on the District for the next several years. In high-elevation SAF stands, WBBB-caused mortality was widely observed—especially north of Whitefish Lake and the upper reaches of Hay Creek and Coal Creek. District-wide, 1,100 DFB-

killed trees were recorded on 630 acres; and just over 940 SAF were killed on 650 acres. A minor amount of ESB-killed ES was also observed. MPB-caused mortality, in several of its hosts, was not significant.

Tally Lake RD. DFB-caused mortality remained one of the more significant management concerns on the District. Dead and dying DF were still found widely scattered throughout DF type, but somewhat less than in 2000. Generally, there were fewer fader groups recorded, but several were larger in area and contained more beetle-killed trees. DF-dominated stands around Tally Lake and in the Logan Creek drainage were particularly heavily infested. Large groups of WBBB-killed SAF were once again mapped in the upper Sheppard Creek drainage, near Elk Mountain, and above Martin Creek. Those outbreaks have expanded in the last year. In total, DF killed 5,300 trees on 3,400 acres; and WBBB killed 2,400 trees on another 3,600 acres. Other beetle-caused mortality was much less commonly found.

Swan Lake RD. Widely scattered groups of DFB-killed DF, GF killed by FE, and WBBB-affected SAF stands were found throughout susceptible host stands on both sides of Flathead Lake. DFB-caused mortality was the most commonly occurring, and has increased from 2000; but groups were generally less than 30 trees each. Some of those DFB-affected stands were more noticeable on Wild Bill and Blacktail Mountains. Minor amounts of WPB-killed PP were recorded near Lake Mary Ronan. Fewer beetle-killed trees were noted in the Crane Mountain area than in 2000.

Many groups of DFB-killed DF, some as large as 200-300 each, were mapped throughout Swan River Valley (on lands administered by both Forest Service and Swan River State Forest) from Swan Lake south to Holland Lake. Major concentrations were noted in Soup Creek, Goat Creek, and Lion Creek drainages. Small amounts of their hosts, killed by ESB and FE, were noted near Lindbergh Lake.

Also widely scattered throughout the reporting area was WBBB-killed SAF at some higher elevation sites. Several groups of LPP killed by MPB were observed near Moore Lake and in Moore Creek and Piper Creek drainages, west of Salmon Prairie. Lesser amounts of MPB-affected LPP were noted south of Lindbergh Lake. Some MPB-killed WBP was mapped in small and scattered groups in the Mission Mountain Wilderness.

In total on the District, bark beetles killed 4,900 DF on 3,400 acres; 390 GF on 250 acres; 40 ES on 20 acres; 1,500 LPP on 750 acres; 535 WBP on 550 acres; and 890 SAF on 830 acres. A few other trees were killed by beetles, but not in meaningful quantities.

Gallatin Reporting Area

Hebgen Lake RD. A significant DFB outbreak continued on both sides of Hebgen Lake; but more damaging amounts of beetle-caused mortality were noted on the west side, in Watkins Creek, Trapper Creek and West Fork Trapper Creek drainages. Though still high, there were generally lesser amounts than recorded there in 2000. There were somewhat larger faded groups noted in Beaver Creek and Cabin Creek drainages to the north, however.

Significant and increasing amounts of WBBB-killed SAF were recorded from Hebgen Lake, north nearly to Big Sky. Largest groups were noted south of Taylor Creek, near Pika Point, in Sage Basin, and above Wapiti Creek. A small group of ES, killed by ESB, was noted in the Cabin Creek drainage, north of Hebgen Lake.

Scattered mortality in WBP stands has been attributed to white pine blister rust in the Madison Range; however there are likely bark beetles also associated with that mortality. Much of the northern portion of the District was not flown in 2001; but on the part that was, 1,430 DF were killed on 1,425 acres; 560 ES were killed on 285 acres; and

8,400 SAF were affected by WBBB on 9,250 acres.

Bozeman RD. Widely scattered WBBB-killed SAF was mapped south of Bozeman in the Gallatin Range, but much of that area was not flown because of activities related to the Fridley Fire. Minor amounts of LPP, killed by MPB were observed southeast of Bozeman in Bear Creek drainage. Secondary bark beetle-caused mortality was also noted in LPP affected by pine-needle sheathminer in that area. In that same general area, small, scattered groups of DFB-killed DF were observed. North of Bozeman, in the Bridger Mountains, more noticeable amounts of DFB-caused mortality were found. Most groups, however, were fairly small and widely scattered. Most of those groups were mapped in Spring Creek and Stone Creek drainages, but small groups were noted near Bridger Bowl Ski area as well. Throughout the District, 385 DF were killed on 160 acres by DFB, and 900 SAF were killed by WBBB on 450 acres. Other mortality was relatively insignificant.

Livingston RD. Small but numerous groups of DFB-caused mortality were once again noted in Mill Creek drainage, south of Livingston. The largest group was mapped near Knowles Peak. That outbreak has been active for several years, but appeared to be less intense than in 2000. About 400 DF were killed on just over 100 acres.

Big Timber RD. DFB was still active throughout the Boulder River drainage. Largest groups of beetle-killed trees were noted from Snowslide Creek south to Box Canyon, but smaller groups were common in many DF stands in that area. Just over 900 trees were killed on about 500 acres.

Helena Reporting Area

Helena RD. Mostly south of Helena, many widely scattered small groups of DFB-caused mortality and PP, killed by MPB, were mapped in 2001. No major concentrations were observed; but significant groups were noted near Strawberry Butte, Park City and in the Tenmile Creek drainage. Several small groups of LPP, killed by MPB in 2000, were located near Chessman Reservoir, southwest of Helena. Additional MPB-killed PP was recorded in scattered, small groups west of Helena. Most of those were in the Sweeney Creek drainage and near the town of Marysville. Ground surveys conducted in fall, 2001 found many DFB-infested DF—most damaged by fire—in areas affected by the Cave Creek and Maudlow-Toston Fires of 2000. We anticipate DFB populations may continue to increase in those areas. Less than 200 DFB-killed DF, on just over 100 acres, were recorded in 2001. Almost 900 PP were estimated to have been killed on almost 425 acres. Other beetle-caused mortality was less significant.

Townsend RD. Numerous but small groups of DF, killed by DFB, were observed in the Crow Creek drainage, west of Townsend. East of Canyon Ferry Lake, small and widely scattered groups of DFB-killed DF and WBBB-affected SAF were located in the Big Belt Mountains. In the Dry Mountain Range, near Songster Butte, numerous small groups of MPB-killed PP were recorded. None of those groups was larger than 60 trees and most were comprised of 15 trees or less. Approximately 700 DF were killed on 500 acres. Another 150 SAF were killed on about 100 acres. MPB killed a combined total of 240 LPP and PP on about 90 acres.

Lincoln RD. DFB-caused mortality was still found in small and scattered groups in DF-dominated forests to the north, south and west of Lincoln. Numerous groups were recorded in the Nevada Creek, Poorman Creek, and Arrastra Creek drainages, and smaller tributaries of the Blackfoot River. In many of those areas, MPB-killed trees were found in lower-elevation PP stands. In the upper Copper Creek drainage, WBBB-affected SAF stands were prevalent. Some of those fader groups covered several hundred acres. To the east of Lincoln, towards Rogers Pass, and eastward to the

Dearborn River, MPB-killed PP was commonly found. Numerous groups of beetle-killed PP were observed in the South Fork Dearborn River and Wolf Creek drainages. In all, about 980 DF were killed on 670 acres; 655 SAF on 850 acres; and around 100 LPP and PP were killed on 130 acres on the District.

Kootenai Reporting Area

Libby/Fisher River RD. Though there has been a general decline in infested area since last year, DFB remained the most important insect pest on the Forest. Very widely scattered, mostly small groups of DFB-killed trees were found in many DF stands. Most notably, numerous groups ranging in size from 150-500 trees were mapped north of the Kootenai River from Libby Dam, west to the Montana/Idaho border (Three Rivers RD). A few large groups and numerous small ones were also mapped south of the River, from Fisher River west past Troy, into stands in the North Callahan and Callahan Creek drainages. Other significant groups were found in Dunn Creek and Big Creek drainages. Larger groups DFB-caused mortality were mapped in upper Fisher River and Cow Creek drainages. Others beetle-killed groups were more widely scattered throughout the host type.

On the combined District, more than 19,200 DF were killed, on about 10,500 acres, in 2000. MPB killed about 500 trees, of all host types, in a widely scattered pattern over 400 acres. Most of that was in WWP stands. WBBB killed almost 300 trees, but on only 180 acres.

Three Rivers RD. DFB outbreaks remained prevalent along the Kootenai River and south towards Bull Lake in 2001. In the upper Yaak River drainage, many WWP stands have been impacted by blister rust; and several of those have experienced MPB-caused mortality. A few large groups of MPB-killed LPP were once again noted near Newton Mountain. Other groups of MPB-killed LPP and WWP were scattered throughout the drainage. District totals showed almost 16,000 DF were killed on 7,500 acres, and MPB killed 2,900 trees (2,600 of them LPP) on 1,100 acres. Small amounts of ESB- and WBBB-killed trees were also noted, but in fairly minor amounts.

Fortine and Rexford RDs. DFB-caused mortality was once again prevalent on both Districts; but was for the most part widely scattered, except for larger groups in the Pinkham Creek drainage, and northwest of Eureka in the Galton Range, from about Clair Creek north to the Canada/US border. Larger groups of DFB-killed DF were noted to the south, in Sunday Creek and its tributaries. Numerous groups of WBBB-killed SAF were mapped in higher-elevation stands—especially in upper Sunday Creek and Grave Creek drainages, and near Ellsworth Mountain. Management activities in the form of pheromone trapping, salvage logging, and hazard reduction has reduced beetle-caused mortality in some stands; however, more than 5,500 acres (roughly half on each District) were still infested by DFB. On those acres, more than 8,200 DF were killed in 2000. SAF mortality totaled 1,400 trees on about 1,600 acres. Other beetle-caused mortality was much less significant.

Cabinet RD. The extent of the DFB infestation on the District has declined slightly, but was still in outbreak status both north and south of the Clark Fork River, west of Rock Creek. The largest groups of beetle-killed DF were recorded in East Fork Elk Creek and Elk Creek drainages to the south, and northward towards Bull Lake. North of the Clark Fork River, infestations were concentrated in Blue Creek, East Fork Blue Creek, Blacktail Creek, Government Creek, and Rock Creek drainages. DFB-killed fader groups were small and widely scattered throughout the Vermillion River drainage. Still numerous, but smaller groups of DFB-killed trees were mapped in the Beaver Creek drainage. In the upper Vermillion River, several groups of MPB-killed WWP were found. On the District, DFB killed a total 18,300 DF on 8,600 acres

in 2000. MPB killed an estimated 320 LPP and 240 WWP on a combined 380 acres. No other beetle-caused mortality was noted in important amounts.

Lewis & Clark Reporting Area

Judith RD. In the Highwood Mountains, small, scattered groups of DFB-caused mortality were noted. Most of that was associated with the significant amounts of root disease found in that area. To the east, near Square Butte, several small groups of MPB-killed PP were located. South and west of Stanford, many small groups of PP, killed by MPB were found near Limestone Butte and in South Fork Judith River drainage. Some of those groups totaled as many as 70 trees. A couple of large groups of SAF, killed by WBBB, were mapped in the Lamb Creek drainage, south of Kings Hill. On the District, almost 900 PP and another 130 LPP were killed by MPB on 775 acres. DFB killed an estimated 125 trees on 50 acres. SAF mortality, attributed to WBBB, totaled 1,340 trees on 720 acres.

Kings Hill RD. In the Little Belt Mountains increasing amounts of MPB-caused mortality were mapped in PP stands. That trend was also widely observed throughout the reporting area. The largest groups of faders, up to several hundred acres each and numbering as many as 10 trees per acre, were located in Pilgrim Creek, Tenderfoot Creek, and Whitetail Deer Creek drainages. Other beetle-killed groups were commonly found, but smaller and more widely distributed.

Also scattered throughout the reporting area, were many groups of SAF killed by WBBB. Some of those groups numbered 500 trees. MPB-killed LPP was less commonly encountered, but was noticeable. Almost 20,500 PP were killed on nearly 3,000 acres; and another 820 LPP, on 420 acres, were also killed by MPB. SAF mortality totaled 5,800 trees on 2,900 acres. About 400 DF were killed in small groups, scattered over 230 acres.

Musselshell RD. The Little Belt and Castle Mountains were the sites of many small and widely scattered groups of PP killed by MPB. Some of the more significant concentrations were found near Dry Gulch and Sawmill Canyon. Large groups of WBBB-killed SAF were found in the upper reaches of North Fork Smith River, and near Mizpah Peak. On BLM-administered land north of Lewistown, in North and South Mocassin Mountains, and the Judith Mountains, many groups of MPB-killed PP were observed. Most groups were less than 25 trees each, but a few numbered more than 100. In North Mocassin Mountains, near Sennett Canyon, observers also noted several small groups of LPP that had been killed by MPB. On the District, about 1,000 trees (both PP and LPP) were killed by MPB. WBBB killed another 500 SAF on 300 acres.

Lolo Reporting Area

Missoula RD. Many, but mostly small, groups of DFB-caused mortality were observed north of Lolo Creek, especially in the Grave Creek drainage. Additional groups were noted from there west to Lolo Pass. Other small groups were mapped near Blue Mountain, west of Missoula. In that same part of the District, and to the south, MPB-killed PP was noted in Sleeman and O'Brien Creek drainages. South, towards Lolo Creek, small and scattered groups of LPP, killed by MPB, were observed.

Many groups of DFB-killed trees, some of them large, were found southeast of Missoula, along the Clark Fork River. DFB-caused mortality was especially noticeable throughout Rock Creek drainage. The largest groups there were recorded in Cinnabar Creek, Brewster Creek, and Gilbert Creek drainages. Also, in Brewster Creek, a small group of PP has been killed by WPB. Several large groups of SAF, killed by WBBB, were noted near Cleveland Mountain. Elsewhere, within the Clark Fork River corridor, small and widely scattered

groups of MPB-killed trees were mapped in many low-elevation PP stands.

North and east of Missoula, especially in the urban-forest interface at the mouth of Rattlesnake canyon, very scattered and mostly small groups of PP, killed by a combination of MPB and WPB, were observed. Several small groups of DFB-killed DF were also noted throughout the Rattlesnake area.

Bark beetle-caused mortality on the District was estimated at: 12,800 DF killed by DFB on 5,900 acres; 375 PP killed by MPB and WPB on a combined 260 acres; 700 LPP killed by MPB on 450 acres; and 570 SAF, on 410 acres, killed by a complex of agents, including WBBB.

Ninemile RD. Many large groups of MPB-killed LPP were noted in the upper Mill Creek drainage, on lands of mixed ownership, north of Frenchtown. One group in that area was comprised of 3,000 faded trees. From there, west, and throughout the Ninemile Creek drainage, aerial observers mapped extensive and large groups of LPP killed by MPB. Some of the larger groups were recorded near Stark Mountain, Lookout Mountain, and Horsehead Peak. Near the latter, one group of 40,000 beetle-killed LPP was recorded.

Near Siegel Pass, there has been some reduction in infested acres—some areas having been affected by fire in 2000; but there still were groups of 30,000 and 40,000 MPB-killed trees between there and Siegel Mountain. Infestations there have begun to decline because of host depletion.

Many large groups of MPB-killed LPP were also mapped south of the Clark Fork River. One of the largest, located above Trout Creek, contained an estimated 20,000 dead trees. Other groups of beetle-killed LPP were noted between Trout Creek and Cedar Creek. Still additional large groups of several thousand acres each and averaging 2-3 faders per acre, were observed near Blacktail Mountain and Mount Baldy. Still others were recorded above Dry Creek. Smaller, but still large groups of MPB-killed LPP were mapped above North Fork of Little Joe Creek.

Scattered MPB-caused mortality, some in association with engraver beetles, was noted in lower elevation PP stands along the Clark Fork River. Smaller and more widely scattered clusters of MPB-killed LPP, and DFB-caused mortality was noted in Fish Creek, North Fork Straight Creek, and Quartz Creek drainages.

Total beetle-caused mortality on the District was recorded as: 115,800 LPP killed by MPB on about 9,600 acres; and another 460 PP, also killed by MPB, on 350 acres. DFB killed 3,900 DF on approximately 1,400 acres; and WBBB killed about 80 SAF on 210 acres. Other beetle-killed trees were less frequently noted and of less importance.

Superior RD. The Superior RD, along with the Plains/Thompson Falls and Ninemile RDs, was the site of the largest MPB outbreak in the State—and the most intense one, in terms of trees per acre killed in the Region. These outbreaks, plus ones in northern Idaho, were the largest recorded in the Northern Region since more than 300,000 acres were infested in 1989. Most of the mature LPP stands on the District, and throughout much of the western portion of the Forest, were experiencing some level of MPB-caused mortality.

South of the St. Regis River, expansive groups of MPB-killed LPP were mapped near Moon Peak, between Deer Creek and Henderson Creek, and above McGee Creek. Groups were still numerous, but more scattered, from there west to Saltese Mountain. North of the St. Regis River, to CC Divide, many very large groups of LPP, killed by MPB, were recorded. Some of the largest were near Camels Hump Lookout and Greenwood Hill. Very large groups of MPB-killed LPP—many numbering in the tens of thousands—were noted at many sites in the Twelvemile Creek drainage.

Mortality was especially intense above Flat Rock Creek and near Brooks Mountain. Other groups of beetle-killed trees were smaller and more widely scattered west towards Lookout Pass.

District-wide MPB-caused mortality in 2000 (recorded as faders in 2001) was estimated at 197,200 trees on 33,800 acres. An additional 1,000 PP were killed by MPB on 420 acres. DFB-killed DF declined throughout the District, but still totaled 7,000 trees on 2,800 acres. Most of that was recorded as fairly small and scattered groups in smaller tributaries of the Clark Fork River, close to St. Regis and Superior. WBBB killed an estimated 500 trees on 180 acres. Other beetle-related mortality was insignificant.

Plains/Thompson Falls RD. An extension of the larger MPB outbreak on the western Lolo NF, the District experienced extremely heavy amounts of beetle-caused mortality in many mature LPP stands. On the eastern edge of the District, a large group of MPB-killed LPP was recorded near Patricks Knob, just west of Clark Fork River. From there west and north, along CC Divide to Prospect Creek, observers mapped very many large groups of LPP, killed by MPB. The largest groups, of 200,000 and 250,000 beetle-killed LPP, were mapped near Sacajawea Peak and Eddy Mountain. Smaller, but still large groups were recorded west to Knox Pass. Smaller groups, and more widely scattered, were noted throughout the southern portion of Prospect Creek drainage, although larger groups were observed near Evans Lake and Glidden Ridge. Other large groups, several numbering 1,000 to 2,000 trees each, were mapped north of the Clark Fork River in Thompson Creek drainage. District-wide there was about a 30% increase in MPB-infested LPP stands since 2000. Ground surveys on the District confirmed the infestation was still building in many stands.

Elsewhere in the reporting area, many groups of DFB-killed DF were still reported; but they were smaller and more widely scattered. Most were north of Thompson Falls and in the upper Thompson River drainage. DFB-caused mortality was also widely scattered throughout Prospect Creek drainage.

In the Fishtrap Creek drainage, particularly in upper elevation sites of several of its tributaries, noticeable amounts of WBP have been affected by blister rust. Many of those trees have also been infested by one or more species of bark beetles. Also, in higher- elevation SAF stands throughout Thompson River drainage, significant amounts of WBBB-killed trees were mapped.

District totals for 2001 showed an estimated 600,500 LPP killed by MPB on approximately 24,400 acres. MPB also killed 780 PP on about 600 acres. Most other beetle-caused mortality pales in comparison; but DFB killed 10,400 trees on 5,600 acres; and WBBB killed 850 SAF on 460 acres.

Seeley Lake RD. Numerous, but small and widely scattered groups of DFB-killed DF and MPB-killed PP were mapped throughout the District. MPB-killed PP were more commonly observed in Blanchard Creek drainage. LPP stands, affected by MPB were seen near Placid Lake and northward to Seeley Lake.

Several small groups of WBBB-killed SAF were observed near Matt Mountain, Morrell Mountain, and McCabe Mountain. WBP stands, affected by blister rust and beetles were mapped near Monture Mountain. Minor amounts of MPB-killed LPP were noted near Rainy Lake. District-wide totals indicated 1,950 DF had been killed on 1,100 acres; 400 SAF were killed by WBBB on 540 acres; and MPB killed 420 trees on 325 acres.

Garnets Mountains (BLM): Few significant groups of beetle-caused mortality was recorded anywhere in the reporting area; but many small and widely scattered groups of DFB-killed DF, MPB-killed PP and LPP,

and WBBB-killed SAF were observed throughout. Somewhat larger groups of LPP killed by MPB, of up to a few hundred trees each, were noted in Union Creek drainage east of Potomac; and east of Elevation Mountain, near the head of Deer Gulch. There were noticeable concentrations of DFB-killed trees near Reynolds Mountain and in the Chamberlain Creek drainage. Other groups of beetle-killed trees, generally less than 30 trees each, were very broadly distributed.

Totals for the area showed 1,200 DF killed by DFB on 415 acres; 382 PP and 220 LPP killed by MPB on a combined 730 acres; another 23 PP killed by WPB (40 acres); and 70 SAF killed by WBBB on 40 acres.

INDIAN RESERVATIONS

Crow IR

In the western portion of the Reservation, in the Pryor Mountains, numerous groups of MPB-killed trees were recorded throughout the PP type. Some groups were as large as 500 trees each. Most of that mortality was found in Pryor Creek, Lost Creek and East Pryor Creek drainages. A group of 200 LPP, also killed by MPB, was mapped near Lost Creek Spring. Several small groups of WBBB-killed SAF, from 2-20 trees each, were recorded in upper Lost Creek drainage.

To the east, in the Wolf Mountains, numerous groups of MPB-killed PP were mapped east of Lodge Grass. Most were small, from 1-70 trees each; but were somewhat generally scattered throughout the PP type in eastern tributaries of Owl Creek to the south, and drainages flowing into Rosebud Creek on the north. Significant concentrations of faders were noted in Cache Creek, Corral Creek, and Thompson Creek drainages.

Reservation totals indicated about 3,000 PP had been killed on 1,140 acres—most of that in the Wolf Mountains. In the Pryors, 200 LPP had been killed on 180 acres and 100 SAF were killed on 20 acres. A small number of DF had also been killed.

Flathead IR

The number of LPP stands, infested by MPB, has increased significantly in the southwestern portion of the Reservation, particularly north and east of Siegel Pass. These outbreaks are a part of those larger MPB population expansions occurring on the Lolo NF, and in other parts of the Region. Two groups, of 5000 beetle-killed LPP each, were mapped just north of Siegel Pass. Other groups in that area ranged from 3-500 trees each. MPB-caused mortality has also increased in both LPP and PP stands along the southern and southeastern edge of the IR, south of Flathead River and east into the Jocko River drainage.

Northward, on both the eastern and western sides of the Reservation, and especially in the Mission Mountains on the east, beetle-caused mortality generally declined in 2001. Although noticeable throughout lower elevation DF stands, DFB-killed trees were less often observed than in 2000. Scattered, small groups of MPB-killed PP and LPP were noted throughout host stands and none seemed to be at higher levels than in 2000. An exception was noted in the northeast corner of the Reservation, just east of Flathead Lake. There, the amount of LPP, killed by MPB, increased markedly. One large group of 5000 trees was mapped just east of East Bay.

Elsewhere in the northern- and eastern-forested portions of the Reservation, beetle incidence has declined from last year. In those areas, MPB-caused mortality in LPP and PP stands and DFB-killed trees were observed in small and widely scattered groups. Reservation totals for 2001 showed 2,960 DF killed by DFB on 1,430 acres; and 24,750 LPP on 5,830 acres and another 4,700 PP on 2,340 acres killed by MPB. Other bark beetle-caused mortality was much less noticeable; however, WPB, ESB, FE, and WBBB killed several hundred trees.

Fort Belknap IR

Numerous groups of MPB-killed PP were observed at several locations on the Reservation and just outside its southern boundary in the Little Rocky Mountains. Most groups contained 25 or fewer faders; but a couple was of 100 trees each. Significant concentrations were mapped near Thornhill Butte and Sugar Loaf Butte, just south of the Reservation. Other stands impacted were noted north of Landusky, and south of Indian Peak. Smaller and fewer fader groups were found near Eagle Child Mountain, along Mission Ridge, and in the Beaver Creek drainage. A few small groups of DFB-caused mortality were observed above Lodge Pole Creek.

Total beetle-caused mortality on the Reservation was about 800 PP killed on 170 acres, and 10 DF killed on 2 acres.

Northern Cheyenne IR

Many, but mostly small and very widely scattered groups of beetle-killed PP were recorded on the Reservation. Significant concentrations were found in the central to eastern portion of the reporting area, although most groups were of 10 trees or less. Fader groups were especially noticeable east of Lame Deer, mostly in tributaries of Rosebud Creek. Aerial observations of PP mortality were recorded as having been caused by MPB. Ground observations, and a history of recent outbreaks on the Reservation suggested most of those beetle-killed trees were actually killed by engraver beetles. There may have been some MPB-related mortality in the western portion of the area. MPB populations developing on the adjacent Crow IR, to the west, may have affected some of those stands. In total, 235 PP were killed on about 300 acres. Management activities being conducted on the Reservation are effectively reducing stand susceptibility and beetle-related mortality.

Rocky Boys IR

With some exceptions, DFB- and MPB-caused tree mortality was recorded in mostly small and widely scattered groups during aerial detection surveys. Ground surveys, however, suggested outbreaks were more widespread than indicated. MPB-killed PP was predominantly found in Sandy and Eagle Creek drainages, and in the southeastern portion of the Reservation, in the Bears Paw Mountains.

DFB-caused mortality was concentrated mostly around Black Mountain and Sawmill Butte. One larger group of DFB-killed DF, numbering 1500 trees, was noted in upper Green Creek drainage.

In that same general area, LPP stands have experienced MPB infestations for the past several years; and much salvage logging and hazard reduction has been conducted there. One small group of LPP faders, killed by MPB, was noted west of Baldy Mountain. Other mature LPP stands on the Reservation are threatened, however.

Beetle-caused mortality, as recorded on aerial detection surveys, totaled 1,860 DF killed on 350 acres; almost 100 PP killed on about 50 acres; and less than 10 LPP killed by MPB. Ground surveys suggested there were other infested areas on the Reservation.

DEFOLIATORS

Western Spruce Budworm

Aerial surveyors mapped 1,300 acres of defoliation by western spruce budworm east of the Continental Divide on the Helena National Forest. Because of the low population levels of budworm in Montana recently, our annual pheromone-trapping program for budworm was limited in scope for 2001. There was a significant increase in number of moths caught at several trapping sites, while number of moths caught at other sites decreased slightly or remained relatively unchanged. In one

stand on the Beaverhead-Deerlodge National Forest, we caught 133 moths in 10 traps. We expect to see increases in budworm populations in 2002 on the Helena and Beaverhead-Deerlodge National Forests. Localized population increases may also be seen on other Montana forests in 2002.

Douglas-fir Tussock Moth

The extremely heavy Douglas-fir tussock moth defoliation on 35 acres that occurred in 2000 in two stands of predominantly Douglas-fir located on the southern portion of the Flathead Indian Reservation northeast of Ravalli was monitored in 2001. Large numbers of overwintering egg masses were observed in early spring, mostly located along the eastern edge of the defoliated area. Only a small number of larvae were found in July, with no visible defoliation present. Many unhatched egg masses and several larvae showing symptoms of virus disease were also observed—evidence that the predicted population collapse had occurred. Many of the trees that were heavily defoliated in 2000 had put on a new flush of needles, though many were dead. Some visible defoliation from 2001 was detected in the same area, but was caused by a population of western false hemlock loopers.

Monitoring of Douglas-fir tussock moth population levels by means of pheromone-baited sticky traps to catch adult males has been done in western Montana since 1979. Traps have been placed at 33 permanent plots. The nearest plot to the 2000 defoliated area was on the Pistol Creek road, about three miles to the northwest. In 1999, trap catches at this plot averaged 63.6 moths per trap. The 2000 average was only 13.8, but in 2001 the average number of moths per trap at the Pistol Creek plot had increased to 55.8 moths per trap. Trap catches at most of the other plot locations also increased in 2001 over 2000 levels (Table 1).

Plot locations where the most moths were caught and numbers of moths were: Pistol Creek (55.8), Jette Lake (50.0), Kerr Dam (22.8), Rocky Point (21.6), Big Arm (13.0), Blue Mountain (10.8), Pattee Canyon (8.6), Butler Creek (8.4), and Petty Creek (7.6). Because of the high trap catches, lower crown larval samples are planned for Pistol Creek, Jette Lake, Kerr Dam and Rocky Point in June of 2002.

Table 1. Douglas-Fir Tussock Moth Trap Catches Western Montana 1994-2001
Average number of male moths per trap

Plot	Location	1994	1995	1996	1997	1998	1999	2000	2001
Albert Creek	14N, 21W, S16	0.0	0.0	0.0	0.0	0.0	0.4	1.2	3.2
Arlee	16N, 20W, S1	0.0	0.0	0.0	0.0	0.0	1.6	0.8	4.6
Big Arm	24N, 21W, S36	0.2	0.0	0.2	0.0	0.0	0.0	0.8	13.0
Big Fork	27N, 19W, S36	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.4
Blue Mountain	13N, 20W, S34	0.0	0.0	0.0	0.0	0.6	1.2	0.4	10.8
Butler Creek	16N, 23W, S24	0.0	0.0	0.2	0.0	0.0	0.4	2.8	8.4
Clear Creek	19N, 24W, S26	0.0	0.0	0.0	0.0	0.0	0.4	*	0.6
Corral Creek	15N, 22W, S36	0.0	0.0	0.0	0.4	0.0	0.6	0.8	1.0
Ferndale	27N, 19W, S32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Fish Creek	14N, 24W, S6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4
Foys Lake	28N, 22W, S36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4
Frenchtown F	14N, 21W, S10	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.8
Frenchtown J	14N, 21W, S22	0.0	0.0	0.0	0.0	0.0	0.2	1.6	2.4
Frenchtown T	14N, 21W, S23	0.0	0.0	0.0	0.0	0.4	0.0	1.4	4.8
Jette Lake	23N, 21W, S2	0.0	0.0	0.8	0.0	0.4	2.0	6.0	50.0
Kerr Dam	22N, 21W, S13	0.0	0.0	0.0	0.0	0.2	0.4	8.6	22.8
Lake Mary Ronan	25N, 22W, S23	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Lakeside	26N, 20W, S6	0.0	0.0	0.0	0.0	0.2	0.0	2.2	0.6
Lolo Creek	11N, 20W, S6	0.0	0.0	0.0	0.2	0.0	0.0	1.0	2.6
Pattee Canyon	12N, 19W, S12	0.0	0.0	0.0	0.0	0.2	0.0	1.2	8.6
Petty Creek	14N, 22W, S19	0.0	0.0	0.0	0.2	0.0	0.8	9.8	7.6
Pistol Creek	18N, 20W, S35	0.4	0.0	0.4	0.4	1.2	63.6	13.8	55.8
Polson-Big Creek	22N, 19W, S21	0.0	0.0	0.0	0.0	0.0	0.6	0.2	3.4
Polson-Hell Roaring	22N, 19W, S33	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.8

Polson-Lost Lake	22N, 19W, S17	0.0	0.0	0.0	0.0	0.2	0.2	3.4	4.6
Revais Creek	17N, 22W, S4	0.0	0.0	0.0	0.0	0.0	0.8	1.6	1.6
Rocky Point	23N, 20W, S4	0.0	0.0	0.0	0.2	0.0	0.6	1.4	21.6
St. Mary Lake	18N, 19W, S35	0.0	0.0	0.0	0.2	0.0	0.0	1.0	4.4
Skidoo Bay	23N, 19W, S2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6
Smith Camp	25N, 20W, S8	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4
Somers # 1	27N, 21W, S27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Somers # 2	27N, 20W, S26	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.6
Worden Creek	12N, 20W, S21	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0

Gypsy Moth

In 2001, a total of 1,086 pheromone-baited sticky traps were placed and retrieved state-wide by four agencies—Montana Department of Agriculture; USDA Animal and Plant Health Inspection Service, Plant Protection and Quarantine; USDA Forest Service; and Montana Department of Natural Resources and Conservation (Table 1). A single moth was caught in a trap placed in Glacier National Park, Glacier County. In 2002, USDA Forest Service will conduct a delimiting survey in the Park to determine if an infestation is present.

In addition to the detection level trapping survey, a delimiting survey was conducted in 2001 due to the capture of a single moth in 2000 near Livingston, Montana, Park County. No gypsy moths were caught in the 14 delimitation traps placed by USDA APHIS PPQ around the 2000 capture site. Based on these results, no infestation appears to exist in the area.

Hemlock Loopers

Approximately 630 acres of defoliation by western false hemlock looper of Douglas-fir on State and private lands was mapped along the east shore of Flathead Lake from Yellow Bay north to Big Fork. Though defoliation was heavy over much of the area, looper populations will very likely collapse by next year, and the trees should mostly recover. Additional defoliation was noted west of Kalispell, near Somers, and near St. Ignatius.

DISEASES

Root Diseases

Root diseases are the most significant disease agents of mortality and growth loss in Montana, mostly west of the Continental Divide. Because root diseases are diseases of the site, we see very little changes occurring from one year to the next. The most significant root diseases in Montana are Armillaria root disease (*Armillaria ostoyae* (Romagn.) Herink), laminated root disease (*Phellinus weirii* (Murr.) Gilb.), annosum root disease (*Heterobasidion annosum (*Fr.) Bref.), and brown cubical root and butt decay (*Phaeolus schweintizii* (Fr.) Pat.). The most susceptible tree species in Montana is Douglas-fir, with grand and subalpine firs taking a close second. The most tolerant species are western larch, pines and western redcedar, with the remaining species falling somewhere along the gradient between susceptible and tolerant. Although root diseases cause

significant amounts of mortality and growth loss, they are also a major agent influencing both structure and species composition across landscapes. Root diseases have greatly influenced succession of vegetation in our forests. This is especially evident in the absence of natural fire cycles. On sites where there is a mixed species component with root disease tolerant serals, root diseases tend to prolong the seral stage on those sites. Root diseases slowly thin out the more root disease-susceptible species (Douglas-fir and true firs), and favor the root disease-tolerant serals.

On grand fir/subalpine fir climax habitats, with a Douglas-fir forest type, low levels of root disease will actually push the stand towards climax faster than in the absence of root disease. This is due to the greater susceptibility of Douglas-fir to root diseases. Although grand fir and subalpine fir are fairly susceptible to root diseases, they are measurably more tolerant than Douglas-fir. Root disease on western redcedar/western hemlock climax sites will also push stands towards climax by weeding out the more root disease susceptible seral species on these sites (Douglas-fir and grand fir).

On sites with a root disease susceptible forest type and climax habitat, very high levels of root disease will maintain an early stand development. Root disease patches experience wave after wave of mortality as trees become large enough for their root systems to contact the inoculum on the site. Trees are unable to grow to a very large size before being killed by root disease.

Mortality from Douglas-fir bark beetle continues to be high in various spots in Montana, which has raised some issues regarding management for Douglas-fir bark beetle (DFB) in root diseased areas. Douglas-fir infected with root disease often harbors endemic levels of DFB which likely aids in the rise of the DFB populations during an outbreak.

Annosum root disease of ponderosa pine is less evident than the above root diseases, but very important in local areas. It has been found causing mortality in ponderosa pine plantations in various locations on the Darby RD, Bitterroot NF, private lands west of Kalispell, and continues to be a significant agent on the Flathead Indian Reservation.

Dwarf Mistletoes

Dwarf mistletoes (*Arceuthobium* spp.) are parasitic plants that extract water and nutrients from living conifer trees. The dwarf mistletoes are native components of western coniferous forests, having co-evolved with their hosts for millions of years. The different dwarf mistletoes are generally host specific. In Montana, lodgepole pine and larch dwarf mistletoes occur throughout the range of their respective hosts while Douglas-fir dwarf mistletoe occurs only in the range of its host west of the Continental Divide.

Because dwarf mistletoes are obligate parasites, ecological forces that have patterned the development of the host tree species have also played roles in influencing the distribution of dwarf mistletoes across the landscape. Fire is one of those influential ecological forces. In general, any fire event that kills host trees will reduce the population of dwarf mistletoes, at least in the short term. The larger and more continuous the fire disturbance, the greater the reduction in dwarf mistletoe populations at the landscape level. Large, complete burns will greatly reduce dwarf mistletoe populations across the landscape and may even eliminate small, localized populations. Small, "patchy" burns will temporarily reduce portions of dwarf mistletoe populations, but infected residuals provide a ready source of dwarf mistletoe seeds for the infection of the newly developing regeneration.

Human influences, including fire suppression and logging, have also had effects on dwarf mistletoe population dynamics. Partial cutting, which created multi-storied stands, and fire suppression may have served to increase the severity of dwarf mistletoes relative to the "pre-settlement" condition. Conversely, dwarf

mistletoes may have been reduced in certain age classes, habitat types, elevation zones or topographic positions that have been intensively managed. Fire suppression and cutting practices that have encouraged shifts in species compositions could have either increased or decreased the disease severity depending on what species of trees and dwarf mistletoes occurred on any given site.

The parasitic activity of dwarf mistletoes causes reduced tree diameter and height growth, decreased cone and seed production, direct tree mortality, or predisposition to other pathogens and insects. It has been estimated that in Montana lodgepole pine dwarf mistletoe causes an average growth loss of 10.5 ft^3/acre/year and larch and Douglas-fir dwarf mistletoes cause average growth losses of 20 ft^3/acre/year in areas where they occur. On the other hand, witches' brooms and tree mortality may result in greater structural diversity and increased animal habitat. Dwarf mistletoe flowers, shoots and fruit are food for insects, birds and mammals. Witches' brooms may be used for hiding, thermal cover, and nesting sites by birds and other mammals. In the long term, heavily infested stands of the host trees can begin to decline, resulting in a successional shift toward other tree species.

Heartwood Stem Decays

The main function of heartwood in live trees is to give individual trees vertical stability. The decay of heartwood weakens this vertical stability, making trees more susceptible to stem breakage. Stem breakage can lead to mortality and subsequent formation of small-scale canopy gaps. The main successional functions of heartwood stem decays are to move stands from a mature closed canopy to a more open canopy and to perpetuate such an open canopy.

Stem decays are important in the creation of wildlife habitat in living trees. Although primary cavity nesters are capable of excavating in sound wood, they selectively excavate in trees and snags with heartwood decay. Most primary cavity nesters do not reuse their holes from one year to the next. Their previous year's holes are then used by a multitude of secondary cavity nesters, which are very dependent on already-created holes for successful reproduction. Thus, cavity-nesting habitat (i.e., heartwood decay) is necessary for the successful reproduction of a number of animal species.

Heartwood decay fungi are also necessary for the formation of hollow trees, which are also important habitat for a number of animal species. Hollow trees are created when decay fungi invade the heartwood of a living tree. The decay may progress to the point that the cylinder of decayed heartwood eventually detaches from the sapwood and slumps down, leaving a hollow chamber. The only way to obtain a hollow dead tree or log is to start with a living tree hollowed out by decay.

Foliage Diseases

Most fungi causing foliage diseases are confined to the needles and leaves, a few attack buds, and some invade young twigs. Foliage diseases are generally more severe in the lower canopy on seedlings, saplings, and small poles than on larger trees. Most of the fungi affect either foliage of the current season or older foliage, but rarely both; it is unusual for all the foliage in either category to be involved. The fungi vary in virulence from year to year according to climatic conditions; heavy infection over a period of years is exceptional. Some trees in a stand are severely infected, but others escape with little or no infection, apparently because of individual resistance. Foliage diseases rarely cause mortality, but they do cause a reduction in growth.

Elytroderma needle blight

Elytroderma needle blight (Elytroderma deformans (Weir) Darker) is the most damaging foliage disease on ponderosa pine in Montana. The fungus infects and kills needles, but it also invades twigs, and causes localized brooms. Spores of the fungus mature in late summer and fall and are dispersed when the needles are wet.

The fungus can live from year to year in invaded bark, so the disease can be perpetuated without conditions favorable for either spore production or infection of new needles.

Localized areas of heavy infection from Elytroderma needle blight were again seen across western Montana in 2001 (TR 01-9). Elytroderma has been heavy in several locations in Montana for a number of years: Jette Lake area north of Polson, Bitterroot Valley south of Missoula, and the Belt Creek Canyon east of Great Falls.

Sphaeropsis (Diplodia) shoot blight and canker

Sphaeropsis shoot blight and canker (also known as Diplodia shoot blight) is caused by the fungal pathogen *Sphaeropsis sapinea* (Fr:Fr) Dyko & Sutton in Sutton. The disease is seen mainly on ponderosa pine (*Pinus ponderosa*) in Montana, but other species can be affected. Damage occurs on current year's growth in the spring as evidenced by shoot dieback, needle stunting, and needle discoloration. Needles turn a straw-like color, then red as the shoot dies and dries out. Resin droplets often exude from the base of infected needles. Cones are infected by the fungus and act as one source of inoculum each spring as spores are spread to new growth by rain-splash. Severity of infections on ponderosa pine varies. In the most susceptible trees, nearly all current-year shoots can be infected, and chronic infections can result in non-vigorous crowns and occasional top-kill. In less susceptible trees only scattered shoots are affected, while some ponderosa pine appear to be resistant and without visible infections. Patterns of infection within a tree's crown vary as well; there may be numerous dead shoots on one side of a tree and few if any on the other.

Casually attributing shoot dieback on ponderosa pine to sphaeropsis shoot blight may lead to an incomplete or incorrect diagnosis. Informal surveys show that western gall rust infections are commonly present towards the ends of branches with shoot dieback, although there is no reason that western gall rust and sphaeropsis shoot blight cannot be present on the same branch. In fact, even small amounts of water stress increase infection by *Sphaeropsis sapinea*, and western gall rust infections may be causing water stress in portions of the branch distal to even small rust galls.

Low levels of damage caused by sphaeropsis shoot blight can currently be seen throughout western Montana. Observations also suggest that ponderosa pine along river bottoms and major drainages may have heavier levels of infection, perhaps due to airflow patterns or other environmental conditions.

Declines

Hazard Tree Management in Recreation Sites

FHP has increased its efforts to provide technical assistance to land managers in the area of hazard trees in recreation sites. Specifically, we provide assistance in the form of site evaluations and on-site training. A new form has been developed which aids in the evaluation of hazard trees and assures proper documentation of the evaluation process. Anyone requesting assistance in hazard tree management should John Schwandt (208-765-7415).

Nursery Diseases

The most important diseases of conifer seedling stock in Montana are caused by several species of *Fusarium*. *Fusarium* species can cause important diseases on both bareroot and container-grown seedlings. The most important diseases caused by *Fusarium* spp. are damping-off of young germinants and root diseases of older seedlings. Other important root pathogens include *Cylindrocarpon* spp., *Pythium* spp. and *Phytophthora* spp. *Cylindrocarpon* spp. are primarily pathogens of container-grown western white pine seedlings; *Pythium* and *Phytophthora* spp

usually damage a wide variety of conifer hosts in bareroot seedling operations.

Botrytis cinerea is an important foliar pathogen that is especially damaging in container nurseries. Western larch and Englemann spruce are especially susceptible. Other important pathogens of conifer seedlings include *Sphaeropsis sapinea, Sirococcus conigenus* (= *S. strobilinus*) and *Phoma eupyrena*, all causing tip dieback diseases on *Pinus* spp. Most tip dieback diseases occur at endemic levels each year; occasionally disease outbreaks occur because of prolonged cool, wet conditions during the spring and early summer.

Efforts to develop alternatives to pre-plant soil fumigation with methyl bromide/chloropicrin for the production of bareroot seedlings have been successful at some nurseries. Some nurseries have adopted alternative chemical fumigants, such as dazomet. Others have successfully grown high-quality seedlings without pre-plant soil fumigation, particularly by using crop rotation and fallowing regimes supplemented with certain organic amendments. Incorporating *Brassica* green manure crops to maintain soil organic matter, improve soil tilth and increase disease suppressiveness is currently being tested. In addition, supplementing fallow or cover crop treatments by incorporating the biological control agent *Trichoderma harzianum* is also being tested. This fungus is an active antagonist of common nursery root-pathogenic fungi.

Recent tests were conducted in conjunction with the Missoula Technology & Development Center to determine efficacy of radio frequency waves to reduce levels of pathogenic fungi within styroblock containers that are reused to grow several crops of conifer seedlings. The radio frequency waves were only effective on containers that had been wetted prior to treatment; water conduction of heat was required to reduce or eliminate pathogens within containers.

Tree Improvement Plantation Diseases

Tree improvement plantations in Montana continue to be damaged by foliage diseases that can adversely affect their utility. The most damaging diseases are caused by *Lophodermella concolor* on lodgepole pine, *Meria laricis* on western larch and *Rhabdocline pseudotsugae* and *Phaeocryptopus gaumannii* on Douglas-fir. The most important impact of these diseases is reduced tree growth; in some cases direct control with pesticides is necessary to ameliorate disease effects.

Another important disease in tree improvement plantations is western gall rust on both ponderosa and lodgepole pine. There are extensive genetic differences in disease susceptibility so that selections for disease resistance can be readily incorporated into tree improvement procedures where the disease occurs at high levels.

SPECIAL PROJECTS

1. Using Green-leaf Volatiles and Verbenone to Protect Hosts from MPB Attack

As part of a two-Region (R-1/4) and two-host (LPP/WBP) project, we conducted a "Green-leaf Volatile/Verbenone" anti-aggregation study in LPP stands on the Lolo NF (Superior RD). The test consisted of 18, 1-acre blocks, each with one of three treatments: verbenone (one of the anti-aggregants produced by MPB) alone; a protectant mixture of green-leaf and non-host volatiles plus verbenone; or none. The study would test the feasibility of protecting small areas from mountain pine beetle attack.

Verbenone treatments were commercially available, 5-gram "pouches." The protectant-mixture treatment was a combination of four bubble capsules: a verbenone bubble capsule (0.5 grams); an alcohol-mix bubble capsule; an aldehyde-mix bubble capsule; and a guiaciol bubble capsule.

A randomized block design, replicated six times was used to test verbenone pouches and “protectant mixtures” against an untreated (control) plot. Each block consisted of three 1-acre plots three chains apart, with five chains between blocks. Treatments, consisting of 40 verbenone pouches per plot, 40 protectant mixtures per plot, or 0 protectants per plot (control), were randomly assigned. In the center of each plot, we hung a funnel trap baited with standard MPB pheromone lures.

Treatments were installed in late June, prior to beetle flight. Evaluations were conducted following beetle flight, in September. Treatment effectiveness was a direct comparison of “new MPB attacks” in each plot.

Treatment Results—Plot Averages

Treatment	Green LPP per Acre	New Attacks per Acre	Percent New Attacks
Check	144	41	22.2
GLV	278	11	3.8
Verb	201	3	1.5

2. Using MCH-Impregnated Beads to Protect DF from DFB Attack

On the Fortine RD, Kootenai NF, we conducted a test of MCH-impregnated polymer beads as a stand-protection treatment against DFB attack; compared to the established standard of 30 MCH bubble capsules per acre.

We treated 12, 5-acre plots with one of three treatments: 4 pounds of beads (4% MCH)/acre; 30 MCH bubble capsules/acre; and no treatment (control). Treatments were randomly assigned. At each plot center, we hung a pheromone-baited funnel trap. Plots were at least 3 chains apart.

Treatments were installed in April, prior to beetle flight. Beads were applied using hand-operated fertilizer spreaders. Evaluations were conducted in November. Treatment effectiveness was measured as a direct comparison of “new” DFB attacks found in each plot.

Treatment Results—Plot Averages

Treatment	Green DF/Acre	New Attacks
Beads	79	0
Bubble caps	87	0
Check	86	7

3. Individual-Tree Protection Using MCH Bubble Capsules

A paired test of 48, large-diameter DF, located in groups of four sets of six pairs each was conducted on Fortine RD, Kootenai NF. In each “pair,” one tree was randomly assigned a treatment with four MCH bubble capsules, placed at each cardinal direction on the tree’s bole at approximately 12 feet off the ground. The other tree in the pair received no treatment. Trees in a pair were at least 100 meters apart; pairs were at least 400 meters apart.

All trees were baited with a “weak” DFB lure composed of frontalin and seudenol.

Treatments were installed in April and evaluated in November. Treatment effectiveness was a direct comparison of “attacked”’ or “not attacked” status of each tree in a matched pair.

Results

Of the 48 trees (24 pairs) in the study, all 24 that had been baited but not treated with MCH were attacked and killed. Three of the 24 that had received MCH treatments were unsuccessfully attacked (had boring dust, but no successful beetle galleries). The other 21 treated with MCH were not attacked.

4. A Verbenone “Observation”

In July 2000, 30 WWP “plus trees” were selected on Three Rivers RD, Kootenai NF (in 2 groups of 15 each). In September 2000, 5 were found to have been killed by MPB (4 in one group, 1 in the other). We considered carbaryl treatments to protect remaining trees; but because of access, elected to treat with verbenone pouches—based on test results in other regions (verbenone pouches are registered for use against southern pine beetle).

Trees averaged about 24 inches d.b.h., so we applied two pouches per tree. Trees were treated in early June; and evaluated in October.

Results

None of the 25 treated trees were attacked in 2001. In one of the two areas, we found four non-treated WWP new attacks in close proximity to treated trees; in the other, we found six new attacks and two strip attacks. While this observation has no statistical validity, it does suggest verbenone pouches may protect high-value hosts from MPB attack.

COMMON AND SCIENTIFIC NAMES

Pathogens

Annosum root disease	*Heterobasidion annosum* (Fr.:Fr.) Bref.	Primary hosts: DF, GF, PP, SAF
Armillaria root disease	*Armillaria ostoyae* (Romagn.) Herink	DF, GF, SAF, sapling pines
Brown cubical butt rot	*Phaeolus schweinitzii* (Fr.:Fr.) Pat.	DF
Dwarf mistletoes	*Arceuthobium* spp.	PP, LP, DF, WL
Brown Stringy rot	*Echinodontium tinctorium* (Ell. & Ev.) Ell. & Ev.	GF, WH
Elytroderma needle cast	*Elytroderma deformans* (Weir) Darker	PP
Fusarium root rot	*Fusarium oxysporum* Schlechtend.:Fr.	DF (Nursery)
Grey mold	*Botrytis cinerea* Pers. ex Fr.	WL (Nursery)
Laminated root rot	*Phellinus weirii* (Murrill) R.L. Gilbertson.	DF, GF, WH, SAF
Sirococcus tip blight	*Sirococcus conigenus* (DC.) P. Cannon & Minter	WWP (Nursery)
Sphaeropsis shoot blight	*Sphaeropsis sapinea* (Fr.:Fr.) Dyko & Sutton in Sutton	PP
Western gall rust	*Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka	LPP, PP
White pine blister rust	*Cronartium ribicola* J.C. Fisch.	WWP, WBP

Insects

Douglas-fir beetle	*Dendroctonus pseudotusugae* Hopkins	DF
Douglas-fir tussock moth	*Orygia pseudotsugata (*McDunnough*)*	DF, TF, ES
Gypsy moth	*Lymantria dispar (*Linaeus*)*	Most hardwoods
Mountain pine beetle	*Dendroctonus ponderosa* Hopkins	All pines
Pine engraver beetle	*Ips pini* (Say)	PP, LPP
Spruce beetle	*Dendroctonus rufipennis* Swaine	ES
Western balsam bark beetle	*Dryocoetes confuses* Swaine	SAF
Western spruce budworm	*Choristoneura occidentalis* Freeman	DF, TF, ES, WI
Western pine beetle	*Dendroctonus brevicomis* LeConte	PP
Fir engraver beetle	*Scolytis ventralis* LeConte	GF, SAF
Hemlock looper	*Lambdina fiscellaria lugubrosa* (Hulst)	DF
False hemlock looper	*Nepytia canosaria* (Walker)	DF

DF = Douglas-fir; GF = Grand fir; TF = True fir; SAF = Subalpine fir; PP = Ponderosa pine; LPP = Lodgepole pine; WWP = Western white pine; ES = Englemann spruce; WH = Western hemlock; WL = Western larch; WBP = Whitebark pine

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Table 2. Acres of host type infested by bark beetles, 1996-2001

	1996	1997	1998	1999	2000[1]	2001
DFB[2]	4,353	3,995	8,310	38,259	34,401	82,273
ESB	1,267	1,502	1,995	830	213	637
IPS	19	513	698	214	11	17
WPB	1,181	857	1,318	1,324	368	670
FE	401	615	523	134	159	1,047
WBBB	4,4673	30,088	59,248	43,472	28,010	27,622
MPB	27,503	34,187	39,198	77,347	40,758	111,626
Total	79,397	71,757	111,290	161,580	103,920	223,892

[1]Not all areas were flown in 2000 due to fires.

[2]DFB=Douglas-fir beetle; ESB= Spruce beetle; IPS=Pine engraver; WPB=Western pine beetle; FE=Fir engraver; WBBB=Western balsam bark beetle; MPB=Mountain pine beetle

Table 3. Douglas-fir beetle-infested acres and new dead trees in Montana, all ownerships, from 1998 through 2001

	1998		1999		2000		2001	
Reporting Area	**Acres**	**Trees**	**Acres**	**Trees**	**Acres**	**Trees**	**Acres**	**Trees**
Beaverhead NF	95	146	★	★	772	1,716	★	★
Bitterroot NF	358	800	1,163	4,619	★	★	11,414	21,649
Custer NF	27	60	0	0	★	★	14	50
Deerlodge NF	319	523	825	1,858	★	★	217	530*
Flathead NF	796	2,093	4,237	15,891	6,329	14,199	14,909	22,813
Gallatin NF	750	1,782	1,234	2,896	1,244*	3,600	2,231	3,214
Helena NF	241	530	584	1,037	273*	740	1,521	2,262
Kootenai NF	2,284	8,475	19,858	59,902	15,352	42,677	32,051	61,132
Lewis & Clark NF	190	276	373	621	★	★	377	761
Lolo NF	2,332	6,305	9,495	32,890	9,660	28,296	17,261	37,126
Garnets	257	674	417	1,333	★	★	415	1,166
Flathead IR	152	265	164	547	771	2,258	1,427	2,960
Crow IR	★	★	★	★	★	★	4	18
Glacier NP	492	1,726	57*	146	★	★	★	★
Yellowstone NP	★	★	★	★	★	★	★	★
Other	16	36	33	50	★	★	433	2,139
TOTAL	8,309	23,691	38,440	121,790	34,401	93,486	82,274	155,820

★ = Not surveyed

*Only partially surveyed

Table 4. Acres of mountain-pine-beetle-caused mortality on State and private lands in Montana from 1998 through 2001

	1998				1999				2000				2001			
Reporting Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	38	2	4	0	★	★	★	★	35	6	12		★	★	★	★
Bitterroot NF	4	824	0	0	0	882	0	0	★	★	★	★	837	0	0	0
Custer NF	4		0	0	0	33	0	0	★	★	★	★	0	108	0	0
Deerlodge NF	120	115	0	0	47	26	0	0	★	★	★	★	347	0	0	0
Flathead NF	142	41	2	944	57	90	12	13	81	46	0	107	362	80	13	41
Gallatin NF	178	4	10	0	69	6	118	0	0*	0*	4	0*	15	2	0	0
Helena NF	21	225	8	0	119	449	12	0	2	94	20	0*	28	1,526	0	0
Kootenai NF	56	31	0	33	15	117	0	63	14	25	0	14	28	58	0	79
Lewis & Clark NF	68	384	0	0	122	827	5	0	★	★	★	★	47	2,238	2	0
Lolo NF	2,040	1,101	0	0	1,819	368	3	7	992	172	0	2	4,170	459	8	0
Garnets	22	314	0	0	20	1,325	0	0	★	★	★	★	22	204	0	0
Crow IR	★	★	★	★	★	664	0	0	★	★	★	★	68	390	0	0
Fort Belknap IR	3	338	0	0	0	113	311	0	★	★	★	★	0	138	0	0
No. Cheyenne IR	★	★	★	★	0	4	0	0	★	★	★	★	0	4	0	0
Rocky Boys IR	198	20	★	0	6	336	0	0	★	★	★	★	0	24	0	0
Flathead IR	53	146	0	0	72	0	0	0	135	624	28	0	481	466	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	2	0	28	0	0
Total	2,947	3,545	24	977	2,346	5,240	461	83	1,259	967	64	125	6,405	5,725	23	120

[1]LPP = Lodgpole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

★= Not surveyed

* = Partially surveyed

Table 5. Acres of mountain-pine-beetle-caused mortality on Federal ownership in Montana from 1998 through 2001

	1998				1999				2000				2001			
Reporting Area	LPP	PP	WBP	WWP	LPP	PP	WBP	W WP	LPP	PP	WBP	WWP	LPP	PP	WBP	LPP
Beaverhead NF	486	4	31	0	★	★	★	★	641	46	169	0	★	★	★	★
Bitterroot NF	63	358	2	0	34	978	10	0	★	★	★	★	146	555	2	0
Custer NF	0	0	0	0	0	416	0	0	★	★	★	★	0	1,158	0	0
Deerlodge NF	350	66	4	0	203	31	6	0	★	★	★	★	976	2	2	0
Flathead NF	1,461	8	32	242	3,936	75	28	64	4,639	100	42	447	13,052	92	767	130
Gallatin NF	119	0	314	0	133	0	7,684	0	6	0*	14	0*	12	0	0	0
Helena NF	78	307	30	0	294	232	30	0	8	8	2	0*	88	590	0	0
Kootenai NF	1,087	74	4	506	83	252	4	834	190	98	0	199	978	95	4	727
Lewis & Clark NF	259	526	4	0	451	724	571	0	★	★	★	★	509	4,126	0	0
Lolo NF	20,087	1,139	8	88	45,558	1,234	61	102	27,217	1,436	10	56	64,745	1,371	201	41
Crow IR	★	★	★	★	0	732	0	0	★	★	★	★	116	748	0	0
Fort Belknap IR	98	1,861	0	0	60	753	0	0	★	★	★	★	0	0	0	0
Flathead IR	1,011	144	0	0	2,005	825	2	0	1,467	1,810	0	0	5,354	1,873	0	0
No. Cheyenne IR	★	★	★	★	0	582	0	0	★	★	★	★	0	290	0	0
Rocky Boys IR	132	88	0	0	30	174	0	0	★	★	★	★	2	22	0	0
BLM (Garnets)	8	27	0	0	10	16	0	0	★	★	★	★	502	2	0	0
Glacier NP	6	0	0	47	0	0	0	0	6	*	*	12	★	★	★	★
Yellowstone NP	★	★	★	★	0	0	0	0	★	★	★	★	★	★	★	★
Total	2,947	3,545	24	977	2,346	5,240	461	83	34,174	3,498	237	714	86,480	10,924	976	898

[1]LPP = Lodgepole pine; PP = ponderosa pine; WBP = Whitebark pine; WWP = western white pine

★ = Not surveyed

* = Partially surveyed

Table 6. Bark-beetle-infested acres (other than mountain pine beetle and Douglas-fir beetle) in Montana, all ownerships, 1998-2001

	Engelmann Spruce Beetle				Pine Engraver Beetle				Western Pine Beetle				Fir Engraver Beetle				Western Balsam Bark Beetle			
Reporting Area	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001	1998	1999	2000	2001
Beaverhead NF	0	★	6	★	382	★	0	★	0	★	0	★	0	★	0	★	18,612	★	18,698	★
Bitterroot NF	16	12	★	27	2	6	★	0	172	134	★	63	4	0	★	34	59	119	★	814
Custer NF	0	0	★	0	0	12	★	0	0	0	★	0	0	0	★	0	37	0	★	630
Deerlodge NF	2	2	★	0	134	74	★	0	28	0	★	2	4	0	★	0	99	291	★	4
Flathead NF	878	304	118	71	0	0	2	0	72	43	64	61	111	79	56	605	760	0	3,407	6,800
Gallatin NF	2	244	53*	287	0	0	0*	0	0	0	0*	2	0	0	0*	0	38,806	37,588	3,123*	9,700
Helena NF	4	22	0*	2	2	2	0*	0	0	2	36*	79	0	0	0*	0	65	89	78*	1,328
Kootenai NF	59	82	8	170	4	14	2	0	224	103	66	156	120	6	26	207	287	718	1,978	1,907
Lewis & Clark NF	2	45	★	8	36	0	★	2	0	0	★	0	0	0	★	16	241	2,671	★	3,940
Lolo NF	34	40	14	30	22	22	0	13	432	893	190	205	253	31	22	95	168	1,019	300	1,677
Garnets	2	0	★	0	3	0	★	0	58	91	★	38	0	2	★	0	2	26	★	43
Flathead IR	4	0	2	42	113	8	7	2	161	59	10	65	26	16	55	90	99	38	72	204
No. Cheyenne IR	★	4	★	0	★	74	★	0	★	0	★	0	★	0	★	0	★	0	★	0
Fort Belknap IR	0	0	★	0	0	0	★	0	0	0	★	0	0	0	★	0	0	0	★	0
Rocky Boys IR	0	0	★	0	0	0	★	0	0	0	★	0	0	0	★	0	0	0	★	0
Crow IR	★	0	★	0	★	0	★	0	★	0	★	0	★	0	★	0	★	0	★	20
Glacier NP	991	37	★	★	0	0	★	★	0	0	★	★	0	0	★	★	14	8	★	★
Yellowstone NP	★	0	★	★	★	0	★	★	★	0	★	★	★	0	★	★	★	0	★	★
Total	1,994	792	201	637	698	212	11	17	1,147	1,325	366	671	518	134	159	1,047	59,249	42,567	27,565	27,067

★ = Not surveyed

* = Partially surveyed

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Figure 1. Areas of 2001 coverage during the Forest Health Protection aerial detection survey in Montana.

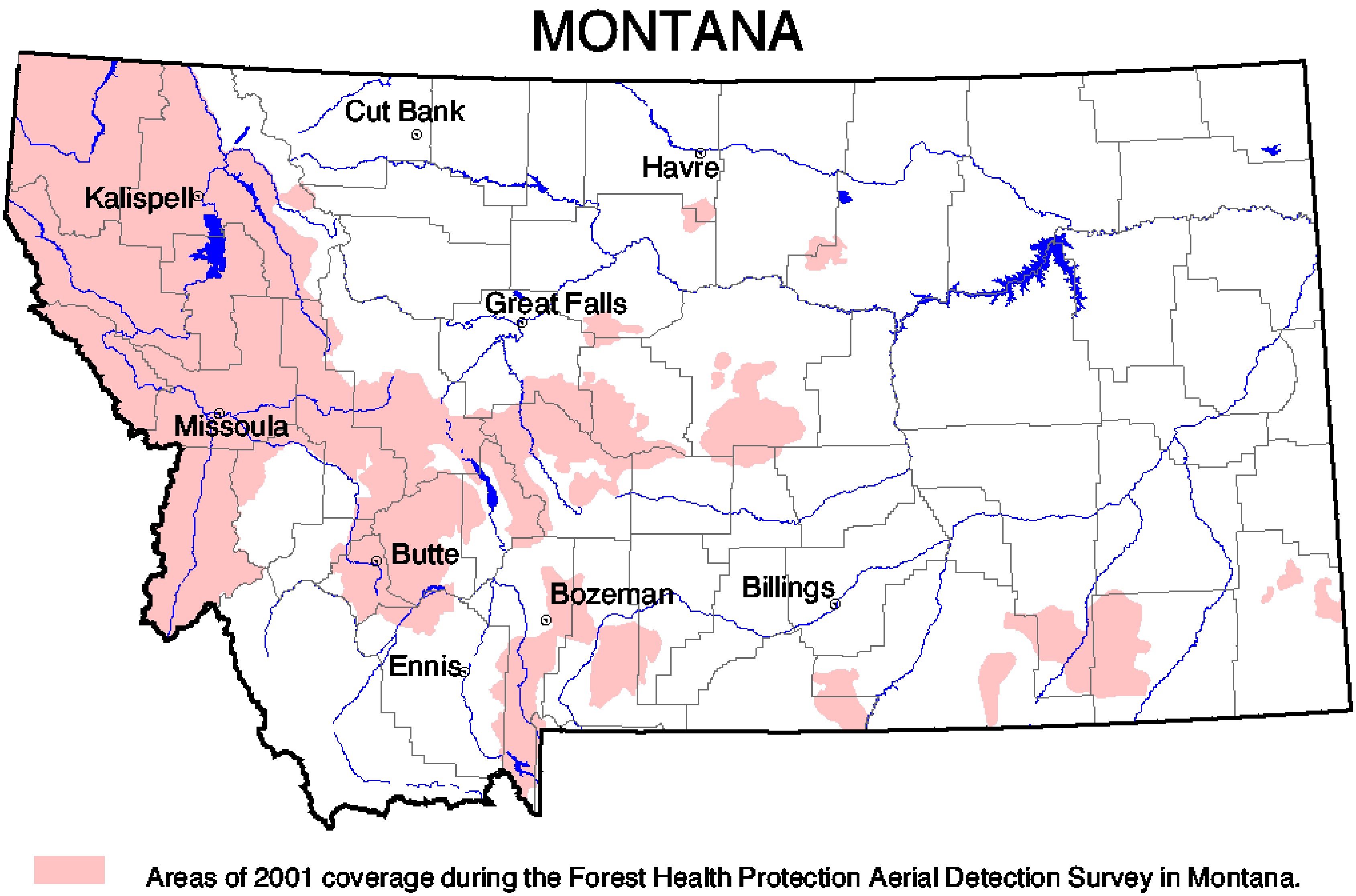

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Figure 2. Douglas-fir beetle infestation in Montana, 2001.

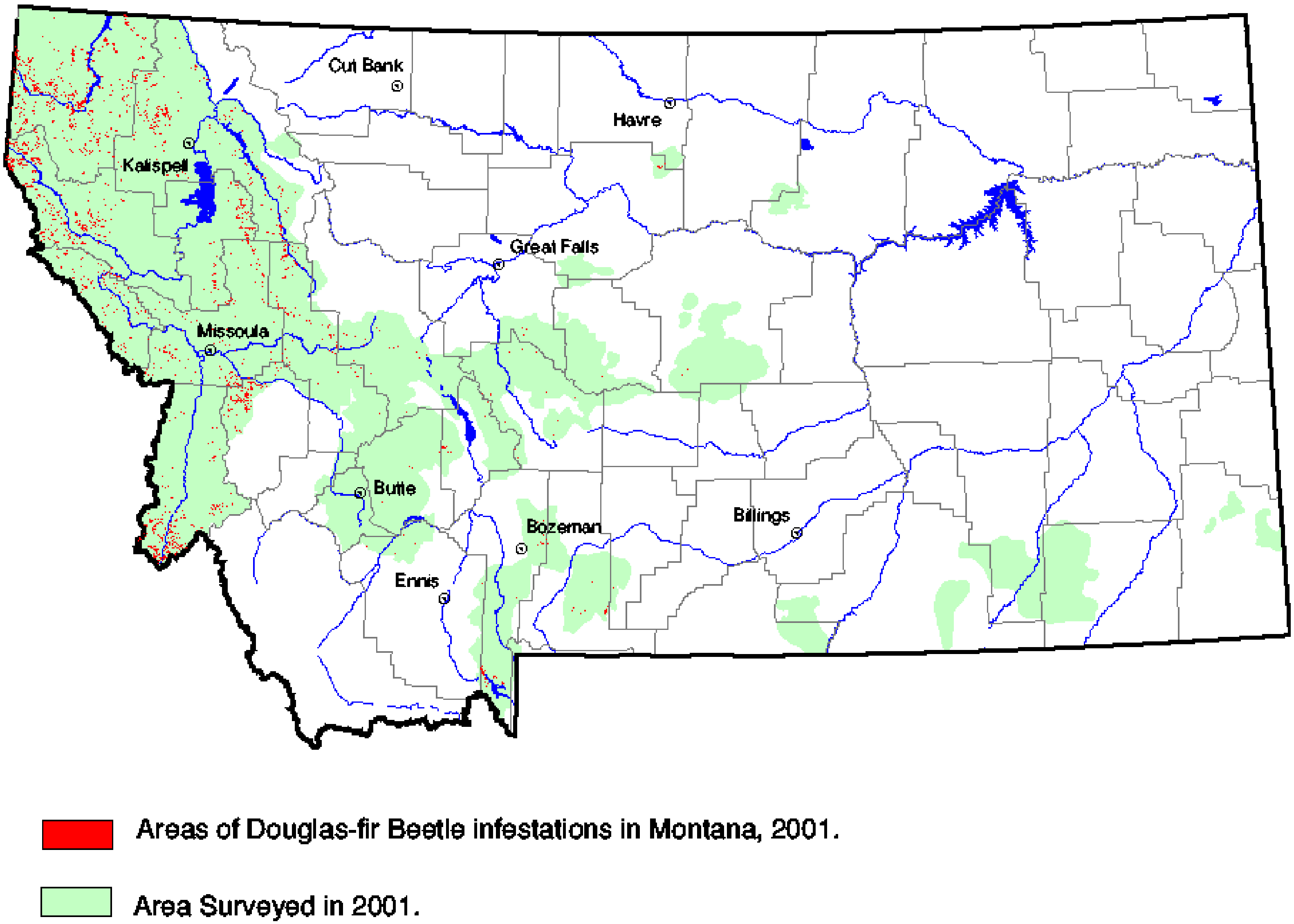

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Figure 3. Mountain pine beetle infestations in Montana, 2001.